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STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

4601 N. Monroe Street • Spokane, Washington 99205-1295 • (509) 456-2926

July 10, 2003,

Dear Advisory Committee Members:

I am responding for the Department of Ecology to the letter sent on May 23, 2003 addressed to Marcie Mangold and Larry Gadbois of EPA from Senators Morton, Mulliken, and Sheahan and Representatives Delvin, Holmquist and Schoesler. I am also responding to questions and comments that arose during a meeting with Ecology, EPA and legislators on June 5th, 2003.

The questions posed in the letter and during the meeting raised some relevant questions regarding the current TMDL process on Moses Lake. Although some of them have been addressed at past advisory committee meetings and at Ecology's meeting with Senator Morton on April 28, 2003, I would like to take this opportunity to clarify our views in this letter. It is very important that all involved understand these issues. Our interest is to have clean water in Moses Lake and across the state to support uses that citizens expect.

I have listed each of the comments below followed by a response.

Question 1. The 1998 303(d) list, and corresponding decision matrices used to arrive at this list, clearly removes Moses Lake from the list of impaired waterways for both nitrogen and phosphorus. If this indeed is the case, and EPA has accepted the list as of January 2000, then why are we developing a TMDL?

Moses Lake was first listed in 1994 based on information collected as part of a federal Clean Lake Project reported by Bain and Moses Lake Conservation District (1987).

Moses Lake was listed for both total phosphorus and total nitrogen because it was thought to be co-limited by these nutrients. Problems identified included blue-green algae, high turbidity, low transparency and aquatic macrophytes.

In 1995, EPA came out with guidance on removal of water bodies from the 303(d) List if "other pollution controls" are in place (Guidance Document for Listing Waterbodies in the Region 10 Section 303(d) Program, Publication No. EPA 910/R-95-003). This guidance was intended to implement federal regulations (40 CFR 130.7(b) (1) (iii)). The guidance required that four criteria be met before Ecology could exclude the water body using the "other pollution controls" rationale. These were:

- 1) An analysis was conducted showing that the proposed or implemented controls were addressing the problem of the impaired uses identified.



- 2) Mechanisms were in place to assure that the controls were implemented.
- 3) The identified problems would be corrected in a reasonable timeframe.
- 4) Monitoring is being conducted or committed to for tracking the effectiveness of the controls.

Our analysis for the 1996 list showed that the completed Phase 2 Clean Lake Restoration Project was adequate to meet the first three EPA criteria above, but there was not any ongoing monitoring being conducted at the time. Therefore, Ecology could not exclude Moses Lake in 1996. The restoration activities that were implemented with this project included dilution with low nutrient water, diversion of irrigation water, and numerous other off-farm nutrient controls.

For the 1998 list, Ecology committed to effectiveness monitoring of Moses Lake. Moses Lake was scheduled for monitoring in 1998. This commitment met the final requirement of the federal regulations; therefore, Moses Lake was excluded from the list per federal regulation and EPA guidance.

More recent information from Moses Lake, including the 1998 effectiveness monitoring data and analyses conducted as part of the Total Maximum Daily Load Phosphorus Study, indicates that Moses Lake is still impaired. In addition, EPA has new guidance that raises the bar on what can be excluded from the list based on "other pollution controls." Based on the information we have on the lake, federal regulations and guidance, and Ecology's listing policy for the 303(d) List, I expect that Moses Lake will be included for phosphorus on the 2002 303(d) List that is scheduled to be released for public comment this fall. The lake is no longer listed for nitrogen since phosphorus has been found to be the limiting nutrient. Further information regarding this listing decision is provided later in this letter.

Question 2. Which designated beneficial uses of Moses Lake are currently not being met? DOE has stated publicly that this system would likely remain eutrophic in a "preimpacted" state. And since the "problem" occurs for approximately one month in a 1-in-10 annual cycle, are we not discussing a problem with a less than 1% (one month in 120) occurrence rate?

Per water quality standards (WAC 173-201A), characteristic uses for Moses Lake include, but are not limited to, the following:

- i. Water supply (domestic, industrial, agricultural).
- ii. Stock watering.
- iii. Fish and shellfish
- iv. Wildlife habitat
- v. Recreation (primary contact recreation, sport fishing, boating, and aesthetic enjoyment)
- vi. Commerce and navigation.

Based on modeling we conducted, we expect that the phosphorus target for the lake is exceeded about 40% of the time. This leads to excessive algal blooms that have the most impact on the recreation use but other uses may also be affected including fishing uses as algae decays and uses oxygen.

The water quality problems in the lake are observed on a yearly basis with the exception of dry years when exceptional amounts of irrigation feed water flows through the lake. In mentioning 1-in-10, you may be referring to our approach to assessing lake conditions as part of a TMDL. We do look at a reasonable "worst-case" scenario. The 90th percentile design flow used in the Moses Lake TMDL evaluation is based on standard application of the once-in-10-year critical loading. In doing so, Ecology is accepting a 10% probability of the criterion being violated. Use of a model requires assumptions. Ecology has traditionally required the use of 7-day low flows with a recurrence interval of 10 years (7Q10 model) for defining critical conditions. This definition of critical conditions is established in the state of Washington water quality standards (WAC 173-201A-020) and is outlined in Ecology and EPA guidance on conducting TMDL studies.

Using conservative assumptions in the TMDL model accounts for uncertainty about the relationship between the pollutant loads to the lake and the resulting lake water quality. The fact that we have established a relatively high phosphorus target of 50 µg/L for Moses Lake supports using the "reasonable worst-case" 90th percentile load for establishing loading as part of the TMDL. Our water quality standards recommend a maximum criterion for lakes in the Columbia Basin Ecoregion of 35 µg/L or less.

As part of our technical assessment of the current and historical data we have concluded that 50 µg/L total phosphorus would be an achievable standard even though the lake will still exhibit some undesirable characteristics. Although we are proposing to use 50 µg/L total phosphorus as the criterion for the lake, it will not become the criterion until we complete the TMDL and it is "approved" by EPA.

Question 3. Why does DOE believe that it is not possible to reach an agreement to reliably deliver Columbia River feed water to this system? DOE again states that if this occurred, the "problem" would be solved.

The US Bureau of Reclamation (USBR) has to protect for flooding as well as provide irrigation water to the irrigation districts, and in some years the system can only handle so much water. At the February 27, 2003 advisory committee meeting, it was suggested that it would be helpful for Bill Gray (USBR) or Dick Erickson (East Columbia Irrigation District) to explain the irrigation system to the advisory committee at a future meeting. Irrigation water could be a component of the final solution for the lake but its availability can not be guaranteed. In addition, there are other phosphorus loading sources that need to be addressed.

Question 4. Why have the internal phosphorus loads within Moses lake, and their cycles, not been considered in model development? Additionally, why have other potentially significant inputs also have not been included (e.g., large numbers of resident and migratory waterfowl)?

The internal phosphorus loads within Moses Lake and their cycles have been considered in model development. Internal loading in some lakes is predictable, but Moses Lake is shallow enough that it can mix several times a year and can vary from month to month. Internal loading in Moses Lake varied 100 percent year-to-year during the 1970s and 1980s, contributing on-average 1/3 of the total phosphorus budget during this time. Based on the 2001 phosphorus budget, internal loading has decreased markedly since the 1980s.

The low internal loading during 2001 may represent an unusual year or may mean that internal loading has actually declined due to fewer algae produced over the years, due to dilution and reduced enrichment of the bottom sediments, a phenomenon that is expected in lakes with decreased phosphorus concentrations. Since the model was calibrated to the lower internal loading of 2001, the model predictions incorporate a lower internal loading rate.

Further investigation into the numbers of resident and migratory waterfowl is necessary to identify whether or not they contribute a significant input to internal phosphorus loading. At the February 27, 2003 advisory committee meeting, it was suggested that it would be helpful for someone like Richard Teals of the Columbia Basin Audubon Society and Jeff Korth of Fish and Wildlife, to discuss current bird populations on Moses Lake and their effect on phosphorus loading with the advisory committee.

Question 5. DOE concluded in its groundwater study that the baseline phosphorus concentration in groundwater feeding into Moses Lake is 50 µg/L. Data from other groundwater feeds that arise as springs within the region, such as Rocky Ford Creek, suggest that this level may be as high as double this concentration. Is it not critical to know this information, and the direction of groundwater flow into the lake and springs, prior to further TMDL development? What testing will be done to develop this information?

The following is an excerpt from the *Moses Lake Total Maximum Daily Load Groundwater Study*:

No evidence was found to indicate that a natural geologic source of phosphate is present that could explain concentrations of phosphorus in ground water above the 0.050 mg/L [same as 50 µg/L] total phosphorus threshold criteria established for the lake. As expected, the large majority of the phosphorus in the study area ground water occurs as orthophosphate. The regional groundwater quality data indicate ambient orthophosphate concentrations are routinely less than 0.050 mg/L in the central Columbia Basin. The orthophosphate concentration for the study area background station is also less than 0.050 mg/L.

For the majority of stations measured during this study, the orthophosphate concentration in groundwater just prior to its discharge to the lake is higher than the 0.050 mg/L total phosphorus threshold criteria.

The direction of ground water flow is discussed in depth in the *Moses Lake Total Maximum Daily Load Groundwater Study* on pages 13 – 16, with Figure 4, Surficial Geology Map (page 10) that identifies general ground water flow direction.

Often in the TMDL process, especially in TMDLs primarily focused on nonpoint pollution, sources are not precisely identified at the beginning of the implementation planning. Frequently there are various sources contributing to the problem. In this situation there are many diffuse sources which may be contributing to high phosphorus levels. Some ideas with regard to sources are presented in the above mentioned *Moses Lake Total Maximum Daily Load Groundwater Study*. Crab Creek has seen some significant changes over the years in reducing phosphorus loading due to agriculture changes. Further identification of sources would definitely help and the identification of this need could be conducted as part of future work.

Question 6. When will definitive economic impact work be completed for each stakeholder interests that is likely to be affected by this TMDL? When will it be available to the committee for review?

A TMDL is a planning process to meet water quality standards. It is not a regulatory requirement and because of that, economic studies are not part of a TMDL. For any regulatory application of TMDLs, economic considerations are part of the analysis before the regulatory requirement becomes applicable. For TMDLs that are primarily focused on nonpoint source pollution, the actions that are identified are largely voluntary.

Question 7. Why is Moses Lake TMDL development seemingly on a "fast-track"? DOE has stated publicly that community efforts at water quality improvement have yielded significant results. EPA guidance document suggest that TMDLs should be developed within 13 years. With Moses Lake removal from the 303(d) list in 1998, we assume that it could have been considered again in the 2002 list, which would give us well into the next decade to respond to these questions and approach water quality with our best available information.

The Clean Water Act requires states to address polluted water bodies. As required by the lawsuit settlement between environmental groups and EPA (Memorandum of Agreement October 29, 1997, <http://www.ecy.wa.gov/programs/wq/tmdl/303moa12.pdf>) Washington has over 600 waterbodies and/or watersheds that need TMDLs by 2013. To get TMDL work completed across the state by the deadline in the lawsuit settlement, Ecology needs to have many TMDLs going on across the state at any one time. This TMDL has been underway since 1998 and is not being fast tracked. Community efforts to improve water quality have yielded significant positive results. However, the water quality of the lake remains a problem (see information further in this letter).

Questions and comments that arose during a meeting with Ecology, EPA and legislators on June 5th, 2003.

A chronology of the events regarding the Moses Lake TMDL process are included in this letter in Attachment A for reference.

Question 1. What are levels of phosphorus in the Lake?

Figure 1 shows a summary of all epilimnetic (near-surface) phosphorus data measured in the lake from 1990 to the present. Epilimnetic data, as opposed to data from deeper waters, are traditionally used for lake assessments because that is the layer where algae grow (due to light availability). The corresponding tabular data are included as Table 1. This represents all near-surface phosphorus data for Moses Lake for the past thirteen years, of which we are aware. Older data are summarized in Welch et al. (1989).

Question 2. What is Ecology's listing policy and what is the basis for proposing Moses Lake for the Draft 2002 303(d) list?

Ecology's listing policy is as follows (Ecology's Water Quality Program Policy 1-11, http://www.ecy.wa.gov/programs/wq/303d/2002-revised/303d_policy_final.pdf):

"For ... phosphorus, ... the assessment decision is based on persistence of the pollutant at levels in excess of the water quality standard. The criterion for persistence is when an exceedence of the standard is indicated for 10% of the water in the segment. ... A segment will be placed on the 303d list if ... the data show a true exceedence percentage in the waterbody segment of 10% or greater." (Page 25 of the listing policy).

"Data Age. Whenever possible, the assessment will be based on data collected in the previous ten years. The precise date will be ten years before the beginning of the "call for data" period." (Page 19 of the listing policy) The call for data for the 2002 list began September 2002; therefore data more recent than September 1992 are considered for listing.

Carroll et al. (2000) and earlier reports document the Moses Lake beneficial use impairments from eutrophication, and Carroll et al. (2000) recommends a criterion of 50 µg/L total phosphorus for the period May through September to protect these uses. This level of total phosphorus is expected to significantly reduce the likelihood of hypereutrophic conditions.

Data for the most recent ten years for the period May through September are shown in Table 2. Figure 2 shows a graph of the same data.

To meet water quality standards and avoid listing, no more than ten percent of measured data should be above 50 µg/L for the May to September period. As shown in Table 2 and Figure 2, more than ten percent of the data are above 50 µg/L for the period May to September; therefore Moses Lake will be proposed to be listed on the 2002 303(d) list for total phosphorus.

Although not used in the formal listing decision making, recent water quality modeling work conducted on Moses Lake indicates that the 50 ug/L proposed criterion is exceeded about 40% of the time.

What is the public process Ecology uses for TMDLs from start to finish?

Each fiscal year, Ecology's regional offices investigate a Water Quality Management Area. This process identifies and prioritizes known and suspected water quality issues within the Water Quality Management Area by assembling input from extensive community involvement and internal Ecology staff. The product is a list of TMDL and other projects scheduled to begin during the ensuing fiscal year.

Public involvement is a vital part of every TMDL. In most cases, the public must develop the real solutions to improving water quality. Our goal is to provide all interested parties with information throughout all phases of the project, from start-up through implementation and effectiveness monitoring. Ecology staff begins with basic explanations of a TMDL, its purpose, sequence, timing, implications, and projected schedule. Later, they provide technical findings as they are developed. Finally, they engage the public in the design of water quality improvement strategies as well as implementation of these strategies.

Below is a brief sequence showing the public participation process associated with considering what TMDL projects to undertake. For specific details regarding the Moses Lake TMDL, please see Attachment A. Months are indicated as a guide in a typical year:

1. Aug/Oct- Pre-investigation: discuss listings and potential TMDL projects with interested parties within a Water Quality Management Area.
2. Oct/Nov - Workshop: considers public input/desires in developing an initial TMDL list for the next fiscal year.
3. Dec/Jan - Post Workshop- discuss proposed list with interested parties and community members. Use comments and finalize project list.
4. Apr/July – Statewide public comment period. Comments are used to modify or adjust final list of projects. Ecology prepares a response to comments received. This document is sent to all of the commenters and is posted to the project's web-site.

The following is an overview of the TMDL Development Process:

1. Quality Assurance Project Plan reviewed with interested parties, public, and tribes. Form a local Advisory Group.
2. Advisory Group continues to participate through reviewing data and technical report development from the Quality Assurance Project Plan. Documents are posted to project's web-site.
3. Submittal Report and Summary Implementation Strategy developed from the technical report and Advisory Group input.
4. Public meetings held with the community on the Submittal Report and Summary Implementation Strategy. Adjustments made to final submittal report due to community input.
5. A formal response to comments is prepared and this Responsiveness Summary becomes part of the TMDL Submittal Report for EPA approval. This is posted to project's web-site.

Detailed Implementation Plan Development:

1. Advisory Group participates by lending local knowledge to designate economically feasible solutions.
2. Detailed Implementation Plan is completed, public meetings held as needed. Detailed Implementation Plan is sent to EPA and posted on the project's web-site.
3. Advisory Group continues to assist with assessing progress and clean-up status.
4. Advisory Group assists with adaptive management as needed.

Tribal consultations are held separately when appropriate to do so.

Question 4. What public involvement is associated with the 303 (d) list?

The 303(d) listing process involves considerable public input. As the basis of listing decisions, Ecology develops a listing policy. Ecology spent about 18 months developing the current listing policy and conducted extensive public outreach and involvement including workshops across the state and meetings with our advisory group, the Water Quality Partnership that primarily includes representatives from businesses and municipalities.

We will be putting the draft list out for a 60 day comment period early this fall. Notification regarding this draft list will be extensive. We will consider input and produce a final list. This list will be submitted to EPA for approval or modification.

Question 5. How was Moses Lake selected for a TMDL? What was the prioritization criteria Ecology used at the time and what was the public process?

The prioritization criteria Ecology used to select Moses Lake for the TMDL process is outlined in the Memorandum of Agreement of October 29, 1997, between the Department of Ecology and the Environmental Protection Agency

(<http://www.ecy.wa.gov/programs/wq/tmdl/303moa12.pdf>). The prioritization criteria are as follows:

“The greatest weight in determining priorities shall be given to the following factors:

- (1) Vulnerability of waterbodies to degradation.
- (2) Risks to public health, aquatic life and other water-dependent wildlife, including threatened and endangered species.

Additional priority setting factors that may be considered are listed below:

- (3) Other designated uses.
- (4) Timing of grant and loan projects.
- (5) Discharge permit issuance and renewal.

- (6) FERC hydroelectric project.
- (7) Existing water quality management plans.
- (8) Public interest and support.
- (9) Priorities from other planning processes, including section 319.
- (10) Ecology short-term programmatic needs and resources.
- (11) Technical feasibility.
- (12) Judicial orders and decisions.
- (13) National policies and priorities.
- (14) Likelihood of success.
- (15) Opportunities for pollution prevention.

Moses Lake was selected as a potential candidate for further study and a TMDL in 1996-1997 when the Mid-Columbia Water Quality Management Area, which is Water Resource Inventory Area (WRIA) 41, was evaluated by Ecology. Ecology pursued a phosphorus TMDL for Moses Lake is because it had, and continues to have, some of the poorest water quality with respect to excessive productivity of all the large lakes and reservoirs in the state. Most years the lake exhibits eutrophic or hypereutrophic characteristics.

Ecology staff personnel carried out the water quality investigation process. Major tasks involved in the investigation process were to develop a Needs Assessment (<http://aww.ecydev/biblio/wq9706.html>) that identified water quality projects including TMDLs for follow up.

In completing the Needs Assessment document and the public workshops related to this process, several water quality concerns became evident. Major concerns of the interested parties were related to water quality and/or water resources, and the coordination of current activities occurring in the watershed. Water quality-water resource concerns pertained to drinking water, decline in fish numbers, contributions of nonpoint source pollutants from irrigation canals, creeks and streams, and lack of, or no water, in creeks and streams. The primary concern in regards to coordination of activities was for the Department of Ecology to work with the various existing organizations as much as possible (Groundwater Management Area, Conservation District partnership, etc.).

Ecology's concerns included the previously mentioned items as well as to increase efficiency, maximize cost effectiveness, and to improve public participation and awareness. Taking into account the communities' needs, the Clean Water Act, and state economic issues, Ecology felt that completing TMDLs in the Moses Lake watershed would be an effective and efficient project for all involved.

We hope that this letter adequately addresses the questions and concerns posed to Ecology in the previously mentioned letter and meetings. We acknowledge that this letter is lengthy, but we felt it was important to summarize the information without sacrificing data for a complete understanding of the entire Moses Lake TMDL process.

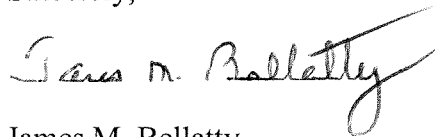
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As mentioned previously in this letter, the draft 2002 303(d) list is currently being prepared for public review. Based on the data from the last 10 years, Moses Lake will likely be listed for total phosphorus on this list. We expect the draft 2002 303(d) list will be out for public comment in early fall. Looking ahead, Ecology would like to request that future options for the Moses Lake TMDL process be discussed with the Advisory Committee. Through the TMDL process it is Ecology's goal to work with the community to achieve cleaner water and meet requirements of the Clean Water Act. We hope that through voluntary programs to reduce phosphorus loading in the lake watershed, it will be possible for Moses Lake to consistently have better water quality than it has had in the past.

Please feel free to contact me at (509) 329-3534 or by email at jbel461@ecy.wa.gov if you have any further questions or comments. You may also contact Marcie Mangold, Moses Lake TMDL lead at (509) 329-3450 or by email at dman461@ecy.wa.gov.

We look forward to working together to improve the water quality and algae conditions in Moses Lake.

Sincerely,



James M. Bellatty
Section Manager
Department of Ecology
Water Quality Program

JMB:MM:slt
Enclosure

cc: Representative Bill Hinkle
Randy Smith, USEPA
Representative Mark Schoesler
Representative Jerome Delvin
Senator Joyce Mulliken
Senator Larry Sheahan

Table 1. All epilimnetic (near-surface) total phosphorus (TP) data for Moses Lake from 1990 to 2003.
Values in excess of 50 ug/L are shown highlighted and bolded.

Data Source	South End of Parker Horn		Rocky Ford Arm		Pelican Horn		South Lake	
	Date	TP (ug/L)	Date	TP (ug/L)	Date	TP (ug/L)	Date	TP (ug/L)
Dept of Ecology Lake Database (contact Dave Hallock or Maggie Bell-McKinnon)	05/22/90	23.2						
	08/23/90	66.26						
Water Quality Monitoring Report by Richard C Bain, Jr. for the Moses Lake Irrigation and Rehabilitation District	06/09/92	19.7	06/09/92	43.9	06/09/92	79.8	06/09/92	24.7
	08/11/92	49.4	08/11/92	74.2	08/11/92	70.4	08/11/92	42.4
Dept of Ecology Lake Database (contact Dave Hallock or Maggie Bell-McKinnon)	06/02/93	50						
	08/25/93	48						
Water Quality Monitoring Report by Richard C Bain, Jr. for the Moses Lake Irrigation and Rehabilitation District	06/05/97	100	06/05/97	140	06/05/97	150	06/05/97	90
	08/13/97	60	08/13/97	120	08/13/97	90	08/13/97	50
Dept of Ecology Lake Database (contact Dave Hallock or Maggie Bell-McKinnon)	06/17/98	98.4 J	06/17/98	57.5	06/17/98	45.1		
	07/15/98	111	07/15/98	67.2	07/15/98	48.1		
	08/12/98	38.5	08/12/98	44.3	08/12/98	48.5		
	09/16/98	69	09/16/98	46	09/16/98	53		
Dept of Ecology Lake Database (contact Dave Hallock or Maggie Bell-McKinnon) (TP measurements for South Lake are composite (average) of surface and 3 meter depth samples)	06/28/00	23	06/28/00	25			06/28/00	28
	07/19/00	32	07/19/00	35			07/19/00	25.5
	08/30/00	54	08/30/00	66			08/30/00	50
	09/27/00	46	09/27/00	47			09/27/00	39.5
Dept of Ecology TMDL Assessment (TP measurements are composite (average) of surface and 3 meter depth samples)	03/29/01	19.25	03/28/01	52.5	03/29/01	19.25	03/29/01	38.5
	04/25/01	18.25	04/25/01	24	04/25/01	18.25	04/25/01	18.25
	05/30/01	18	05/30/01	22	05/30/01	18	05/30/01	32
	07/02/01	13.5	07/02/01	15.5	07/02/01	13.5	07/02/01	12.5
	08/01/01	24	08/01/01	31.75	08/01/01	24	08/01/01	15.75 U
	08/29/01	13.25 U	08/29/01	19.1	08/29/01	13.25 U	08/29/01	13.8 U
	09/26/01	15.25 UJ	09/26/01	19.5 UJ	09/26/01	15.25 UJ	09/26/01	25.75 UJ

All samples taken from 0.5 m depth unless otherwise noted.

Data qualifiers: (J = estimate; U = not detected at or above detection limit; UJ = not estimated or detected at or above estimated detection limit); reported detection limit used in composite.

Table 2. Epilimnetic (near-surface) total phosphorus (TP) data for Moses Lake from September 1993 through September 2003, summer season only (May through September), and assessment of exceedences over the proposed 50 ug/L TP criterion.

Data Source	South End of Parker Horn		Rocky Ford Arm		Pelican Horn		South Lake	
	Date	TP (ug/L)	Date	TP (ug/L)	Date	TP (ug/L)	Date	TP (ug/L)
Dept of Ecology Lake Database (contact Dave Hallock or Maggie Bell-McKinnon)	06/02/93	50						
	08/25/93	48						
Water Quality Monitoring Report by Richard C Bain, Jr. for the Moses Lake Irrigation and Rehabilitation District	06/05/97	100	06/05/97	140	06/05/97	150	06/05/97	90
	08/13/97	60	08/13/97	120	08/13/97	90	08/13/97	50
Dept of Ecology Lake Database (contact Dave Hallock or Maggie Bell-McKinnon)	06/17/98	98.4 J	06/17/98	57.5	06/17/98	45.1		
	07/15/98	111	07/15/98	67.2	07/15/98	48.1		
	08/12/98	38.5	08/12/98	44.3	08/12/98	48.5		
	09/16/98	69	09/16/98	46	09/16/98	53		
Dept of Ecology Lake Database (contact Dave Hallock or Maggie Bell-McKinnon) (TP measurements for South Lake are composite (average) of 0.5 and 3 meter depth samples)	06/28/00	23	06/28/00	25			06/28/00	28
	07/19/00	32	07/19/00	35			07/19/00	25.5
	08/30/00	54	08/30/00	66			08/30/00	50
	09/27/00	46	09/27/00	47			09/27/00	39.5
Dept of Ecology TMDL Assessment (TP measurements are composite (average) of 0.5 and 3 meter depth samples)	05/30/01	18	05/30/01	22	05/30/01	18	05/30/01	32
	07/02/01	13.5	07/02/01	15.5	07/02/01	13.5	07/02/01	12.5
	08/01/01	24	08/01/01	31.75	08/01/01	24	08/01/01	15.75 U
	08/29/01	13.25 U	08/29/01	19.1	08/29/01	13.25 U	08/29/01	13.8 U
	09/26/01	15.25 UJ	09/26/01	19.5 UJ	09/26/01	15.25 UJ	09/26/01	25.75 UJ
Sample size		17		15		11		54
Actual number of exceedences		6		5		3		15
			Minimum # exceedences needed to list		List?		Yes	
Lake Total								

All samples taken from 0.5 m depth unless otherwise noted.

Data qualifiers: (J = estimate; U = not detected at or above detection limit; UJ = not estimated or detected at or above estimated detection limit); reported detection limit used in composite calculation

Minimum # exceedences required to place a waterbody on the 303(d) list, using binomial distribution, with a 90% confidence that the true exceedence percentage in the waterbody is greater than or equal to 10%.

All samples taken from 0.5 m depth unless otherwise noted.

Data qualifiers: (J = estimate; U = not detected at or above detection limit; UJ = not estimated or detected at or above estimated detection limit); reported detection limit used in composite calculation

Minimum # exceedences required to place a waterbody on the 303(d) list, using binomial distribution, with a 90% confidence that the true exceedence percentage in the waterbody is greater than or equal to 10%.



Figure 1. All epilimnetic (near-surface) total phosphorus (TP) data for Moses Lake from 1990 to 2003.

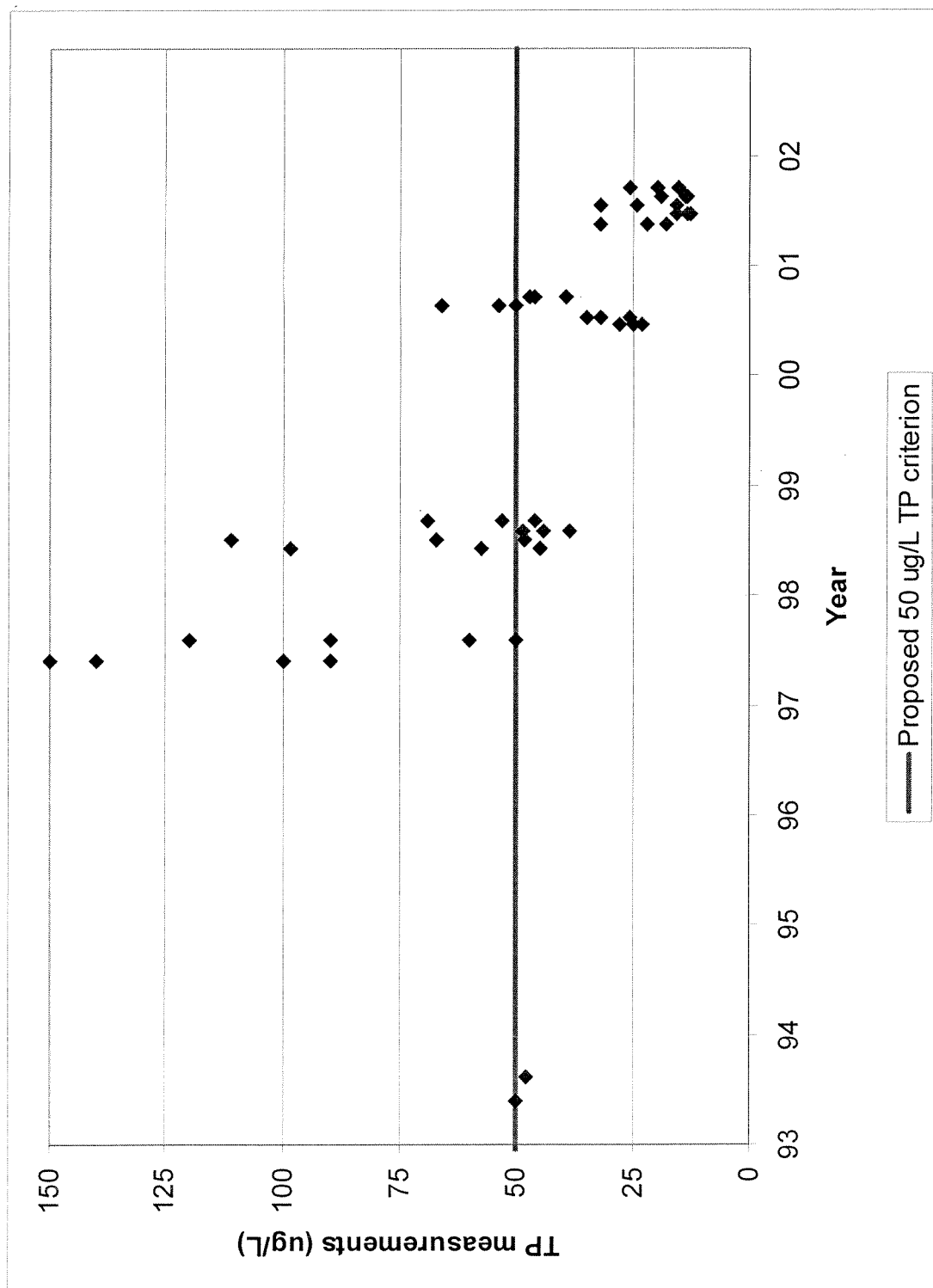


Figure 2. Epilimnetic (near-surface) total phosphorus (TP) data for Moses Lake from September 1993 through September 2003, summer season (May through September) only

Attachment A: Chronology of Moses Lake TMDL-related Events.

- 1993** June 6th and August 25th, Ecology sampled three stations on Moses Lake. Chlorophyll a and especially nutrient concentrations were generally high, mostly in the eutrophic range. Conclusions: water quality was extremely poor in Moses Lake in 1993. Water diversion was low during this year. Recommendations: Moses Lake should be monitored for conventional water quality parameters, both because the 1993 assessment was not based on a year of typical diversion flows and because regular monitoring is required to remove the lake from Ecology's 303(d) list. (Watershed Briefing Paper for the Mid-Columbia Basin Watershed, Sept. 1996)
- 1996** Moses Lake was listed for phosphorus and nitrogen on the 303(d) list (Submitted by Ecology May 1996, approved by EPA April 1, 1997). Rationale: Per EPA guidance, although a lake restoration plan had been prepared, this lake could not be excluded from the list under federal regulation 40 CFR 130.7(b)(1)(iii) since there was no known trophic state monitoring occurring to assure the effectiveness of the controls put in place.
- 1996** August through November. As part of Ecology's annual process of determining which TMDL studies to start the following year, Ecology held a series of meetings in the geographic area referred to as the "Mid-Columbia Water Quality Management Area" to get input on relative priorities:
- Aug. 27, 1996 – Adams County Conservation District
 - Aug. 28, 1996 – Department of Transportation
 - Aug. 29, 1996 – Northwest Council of Government
 - Aug. 29, 1996 – Adams and Lincoln County (Lincoln Co. Commissioner, Adams Co. Public Works, and Health District)
 - Sept. 5, 1996 – Cities in Mid-Columbia
 - Sept. 6, 1996 – US Bureau of Reclamation
 - Sept. 11, 1996 – NRCS and Upper Grant Conservation District
 - Sept. 19, 1996 – Fish and Wildlife
- 1997** March-April. TMDL projects were recommended as high priority for Moses Lake, Rocky-Ford Creek, and Lower Crab Creek (Crab Creek from the outlet of Moses Lake to the Columbia). However, due to staff resource limitations, Rocky-Ford Creek was the only project started in 1997. Work on the Rocky Ford Creek technical study was conducted from mid-1997 to September 1998.
- 1998** July. Ecology started a new project to evaluate whether existing information on Moses Lake could be turned into a TMDL. The work included a literature review and analysis of historical data. Work on this phase of the Moses Lake technical study was conducted from mid-1998 to October 2000.
- 1998** September. Ecology published "Rocky Ford Creek TMDL Study," Pub. No. 98-326. Ecology found that nutrient concentrations were high in the creek. One of the major conclusions of the study was that nutrient limits for Rocky Ford Creek should be set in the context of what was needed for Moses Lake, at least initially. That is, Moses Lake should first be looked at as a whole, with nutrient reductions set for all of the tributaries and other sources concurrently. Then later, Rocky Ford Creek could be re-evaluated to see if the initial reductions were sufficient to meet water quality standards in the creek, or if further reductions were needed.
- 1998** June 29th – 1998 303(d) list submitted to EPA which did not include Moses Lake (see explanation contained in this letter).

- 1999** February. Ecology distributed a draft Moses Lake phosphorus TMDL report for technical peer review. The report summarized historical studies and other major documents associated with the lake and presented the results of a steady-state analysis of phosphorus loading to the lake using the historical data (no new data were collected by Ecology for this report). ("Steady-state" means the model looked at the lake on a whole-summer basis and did not show how the lake changed over the course of a season. It also looked at the entire lake as a whole and not at the individual arms.) The draft report recommended a 50% reduction in total phosphorus for the tributaries and groundwater sources to meet the proposed phosphorus criterion of 50 µg/L. (This report was later published with the title "Moses Lake Proposed Phosphorus Criterion and Preliminary Load Allocations Based on Historical Review."; see October, 2000, below.)
- 2000** February. Ecology held a public meeting in the Moses Lake Armory to present the results of the Rocky Ford Creek Study to the public. Public reaction was favorable for addressing the nutrient problem in both Rocky Ford Creek and Moses Lake.
- 2000** February. Ecology decided that additional data collection was needed to supplement the historical information before establishing final TMDL allocations for Moses Lake, its tributaries, and other nutrient sources. This was partly due to a relative lack of data (compared to other sources) from upper Crab Creek and groundwater. Also, it was felt that a complete and current data set for the entire basin (all collected during the same year) would form a better basis for final TMDL allocations.
- 2000** April. Ecology held another meeting in Moses Lake with the public about Rocky Ford Creek.
- 2000** October. Ecology published the phosphorus TMDL report titled "Moses Lake Proposed Phosphorus Criterion and Preliminary Load Allocations Based on Historical Review," to document the work that had been done to-date with historical data and steady-state modeling (Pub. No. 00-03-036). As mentioned previously, the report indicated that 50% reductions of tributary and groundwater phosphorus loading would likely be needed to meet the 50 ug/L target. The report also recommended collecting one year of additional data from the entire basin concurrently and developing a dynamic (showing changes over the season) computer model of Moses Lake to determine the seasonal and spatial (by geographic area) effects of phosphorus loading.
- 2001** January. Technical Advisory Committee Meeting: review of executive summary from Moses Lake Proposed Phosphorus Criterion and Preliminary Load Allocations Based on Historical Review. The Technical Advisory Committee consisted of representatives of the City and County Planning Departments, All irrigation districts (Moses Lake, Quincy, East Columbia Basin, South Columbia Basin, US Bureau of Reclamation, Environmental Protection Agency, and Ecology).
- 2001** March-October. Data were collected from Moses Lake, groundwater, and tributaries as recommended in the October 2000 report. The project plan for this data-collection work was published in April 2001 (*Moses Lake Phosphorus TMDL Study Quality Assurance Project Plan*). The data was used to calibrate a 2-dimensional hydrodynamic (water flow) and water quality model of the lake that could be used to more accurately predict the lake total phosphorus concentrations under different flow and phosphorus loading conditions. This phase of the Moses Lake technical work extended through December 2002.
- 2002** January. A public meeting was held to review preliminary data from the new technical study for Moses Lake.

- 2002** September. A public meeting was held to discuss the Moses Lake TMDL process, advisory committee function, and to begin selection of committee members. Committee formed through nomination and volunteers.
- 2002** December. A public meeting was held to present the data and analyses in the draft Moses Lake TMDL technical and supporting groundwater report. The draft TMDL report recommended a 35% reduction in total phosphorus loading from tributary and groundwater sources. The combination of using more recent data and dynamic computer modeling led to the change in the proposed percent reduction needed to meet the lake phosphorus criterion.
- 2003** January. Moses Lake Advisory Committee Meeting: discussed the process and procedure for meetings and components of the Summary Implementation Strategy (outline of current and possible future BMPs).
- 2003** February. Moses Lake Advisory Committee Meeting: question and answer session with Ecology's investigator, Jim Carroll, as requested by advisory committee.
- 2003** May. Moses Lake Advisory Committee Meeting – scheduled presentations from the City of Moses Lake and Grant County Health District to provide insight to possible sources of phosphorus, current BMPs and future BMPs. Conclusion of meeting – all further meetings postponed until questions presented during the meeting are answered by the Department of Ecology and Environmental Protection Agency.

References from chronology:

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